

Attorney Docket No.: 01CON281P

REMARKS

By the present amendment and response, claims 1, 5, 6, 11, 15, and 16 have been amended to overcome the Examiner's objections and claims 4 and 14 have been canceled. Thus, claims 1-3, 5-13, and 15-20 remain pending in the present application. Reconsideration and allowance of pending claims 1-3, 5-13, and 15-20 in view of the following remarks are requested.

The Examiner has rejected claims 1-4, 8, 9, 11-14, 18, and 19 under 35 USC §103(a) as being unpatentable over U.S. patent number 5,786,738 to Ikata et al. ("Ikata") in view of Sholley. For the reasons discussed below, Applicant respectfully submits that the present invention, as defined by amended independent claims 1 and 11, is patentably distinguishable over Ikata and Sholley, singly or in combination.

The present invention, as defined by amended independent claim 1, teaches, among other things, at least one laminate substrate reference via situated at a side of an antenna, "said at least one laminate substrate reference via being electrically connected to said laminate substrate reference pad, said at least one laminate substrate reference via being electrically connected to a printed circuit board reference pad in a printed circuit board," where the laminate substrate reference pad is situated over the antenna. As disclosed in the present application, the present invention provides a structure comprising a laminate substrate having a top surface for receiving a semiconductor die, an antenna situated on a bottom surface of the laminate substrate, a laminate substrate reference pad situated in the laminate substrate and over the antenna. As disclosed in the present

Attorney Docket No.: 01CON281P

application, the present invention provides laminate substrate reference vias situated at the sides of the antenna and electrically connected to the laminate substrate reference pad and electrically connected to a printed circuit reference pad in a printed circuit board. As a result, the present invention provides shielding between the semiconductor die and the antenna and also shields the sides of the antenna from the environment.

Also, by attaching the semiconductor die directly to the top surface of the laminate substrate and fabricating an antenna on the bottom surface of the laminate substrate, the present invention advantageously provides a structure that does not require the additional processing cost of forming a cavity to place the semiconductor die in or the additional cost of assembling an antenna as a discrete component. Furthermore, by electrically connecting the laminate substrate reference pad to the printed circuit reference pad on the printed circuit board, the present invention provides additional shielding for the sides of the antenna while allowing radiation to be emitted and received by the antenna.

In contrast to the present invention as defined by amended independent claim 1, Ikata and Sholley do not teach, disclose, or suggest at least one laminate substrate reference via situated at a side of an antenna, "said at least one laminate substrate reference via being electrically connected to said laminate substrate reference pad, said at least one laminate substrate reference via being electrically connected to a printed circuit board reference pad in a printed circuit board," where the laminate substrate reference pad is situated over the antenna. Ikata specifically discloses multi-layer ceramic package 62 comprising four layers 62₁-62₄, filter chips 33a and 33b, which are mounted on chip

Attorney Docket No.: 01CON281P

mounting surface 63 of layer 62₃, common grounding pattern 72, which is situated between two sub-layers of layer 62₃, and phase matching circuit pattern 68, which is formed on the underside of layer 62₃. See, for example, column 8, lines 42-67, column 9, lines 18-20, column 10, lines 29-33, and Figure 14 of Ikata.

In Ikata, a phase matching circuit pattern, such as phase matching circuit pattern 68, is utilized to establish a desirable line impedance. See, for example, Ikata, column 2, lines 1-6 and 15-29. Thus, phase matching circuit pattern 68 is not an antenna as specified by amended independent claim 1, but is rather a circuit for providing phase matching and establishing the line impedance. Furthermore, Ikata fails to teach, disclose, or suggest an antenna situated on a bottom surface of a laminate substrate as specified in amended independent claim 1.

Additionally, in Ikata, common grounding pattern 71 is connected to grounding terminals 66d formed on the bottom of duplexer 71 by castellations 66d₁, which are formed on the side of multi-layer ceramic package 62. See, for example, column 10, lines 34-45 and Figures 11, 14, and 15 of Ikata. However, as discussed above, common grounding pattern 71 is connected to grounding terminals 66d by castellations 66d₁, which are formed on the side of multi-layer ceramic package 62. As such, castellations 66d₁ are not laminate substrate reference vias as specified in amended independent claim 1. Furthermore, Ikata fails to teach, disclose, or suggest at least one laminate substrate reference via being electrically connected to a laminate substrate reference pad, as specified in amended independent claim 1. Moreover, Ikata fails to teach, disclose, or

Attorney Docket No.: 01CON281P

suggest a laminate substrate reference pad connected to a printed circuit board reference pad by at least one laminate substrate reference via.

Sholley specifically discloses a millimeter wave (MMW) device, which includes cavity 27 for accommodating monolithic microwave integrated circuit (MMIC) chips. See, for example, column 6, lines 4-11 and Figure 2 of Sholley. Sholley states that since the wavelength is so short, a small electrical lead from a component or interconnection may serve as a full or half-wave antenna, and radiate MMW energy from the lead into open space. See, for example, Sholley, column 1, lines 45-55. As disclosed in Sholley, MMW devices operate at very high frequencies, e.g., 45 Gigahertz to 120 Gigahertz and higher. However, the duplexers, such as duplexer 31, disclosed in Ikata operate at much lower frequencies, e.g., less than 1.0 Gigahertz. See, for example, Ikata, column 7, lines 49-67. Thus, disclosure that a lead can act as an antenna at the very high frequencies disclosed in Sholley does not apply to phase matching circuit pattern 68 in Ikata, which operates at a much lower frequency.

Furthermore, Sholley fails to teach, disclose, or suggest at least one laminate substrate reference via situated at a side of an antenna, where the at least one laminate substrate reference via is electrically connected to a laminate substrate reference pad, where the laminate substrate reference pad is situated over the antenna. Moreover, Sholley fails to teach, disclose, or suggest a laminate substrate reference pad that is electrically connect to a printed circuit board reference pad by at least one laminate

Attorney Docket No.: 01CON281P

substrate reference via. Thus, the disclosure of Sholley fails to cure the deficiencies of Ikata.

For the foregoing reasons, Applicant respectfully submits that the present invention, as defined by amended independent claim 1, is not suggested, disclosed, or taught by Ikata and Sholley, either singly or in combination thereof. As such, the present invention, as defined by amended independent claim 1, is patentably distinguishable over Ikata and Sholley. Thus claims 2-3, 8, and 9 depending from amended independent claim 1 are, *a fortiori*, also patentably distinguishable over Ikata and Sholley for at least the reasons presented above and also for additional limitations contained in each dependent claim.

The present invention, as defined by amended independent claim 11, teaches, among other things, each of a plurality of laminate substrate reference vias situated at a side of an antenna, "said each of said plurality of laminate substrate reference vias being electrically connected to said laminate substrate reference pad, said each of said plurality of laminate substrate reference vias being electrically connected to a printed circuit board reference pad in a printed circuit board," where the laminate substrate reference pad is situated over the antenna. The present invention, as defined by amended independent claim 11, provides similar advantages as the invention as defined by amended independent claim 1 discussed above. Thus, for similar reasons, Applicant respectfully submits that the present invention, as defined by amended independent claim 11, is also not suggested, disclosed, or taught by Ikata and Sholley, either singly or in combination

Attorney Docket No.: 01CON281P

thereof. As such, the present invention, as defined by amended independent claim 11, is patentably distinguishable over Ikata and Sholley. Thus claims 12-13, 18, and 19 depending from amended independent claim 11 are, *a fortiori*, also patentably distinguishable over Ikata and Sholley for at least the reasons presented above and also for additional limitations contained in each dependent claim.

The Examiner has further rejected claims 5-7, 10, 15-17 and 20 under 35 USC §103(a) as being unpatentable over Ikata and Sholley, and further in view of U.S. patent number 6,282,095 to Houghton et al. As discussed above, amended independent claims 1 and 11 are patentably distinguishable over Ikata and Sholley and, as such, claims 5-7 and 10 depending from amended independent claim 1 and claims 15-17 and 20 depending from amended independent claim 11 are, *a fortiori*, also patentably distinguishable over Ikata and Sholley for at least the reasons presented above and also for additional limitations contained in each dependent claim.

Based on the foregoing reasons, the present invention, as defined by amended independent claims 1 and 11 and claims depending therefrom, is patentably distinguishable over the art cited by the Examiner. Thus, claims 1-3, 5-13, and 15-20 pending in the present application are patentably distinguishable over the art cited by the Examiner. As such, and for all the foregoing reasons, an early allowance of claims 1-3, 5-13, and 15-20 pending in the present application is respectfully requested.

Attorney Docket No.: 01CON281P

Respectfully Submitted,
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